Assessment of the ECCO2 optimized solution in the Arctic

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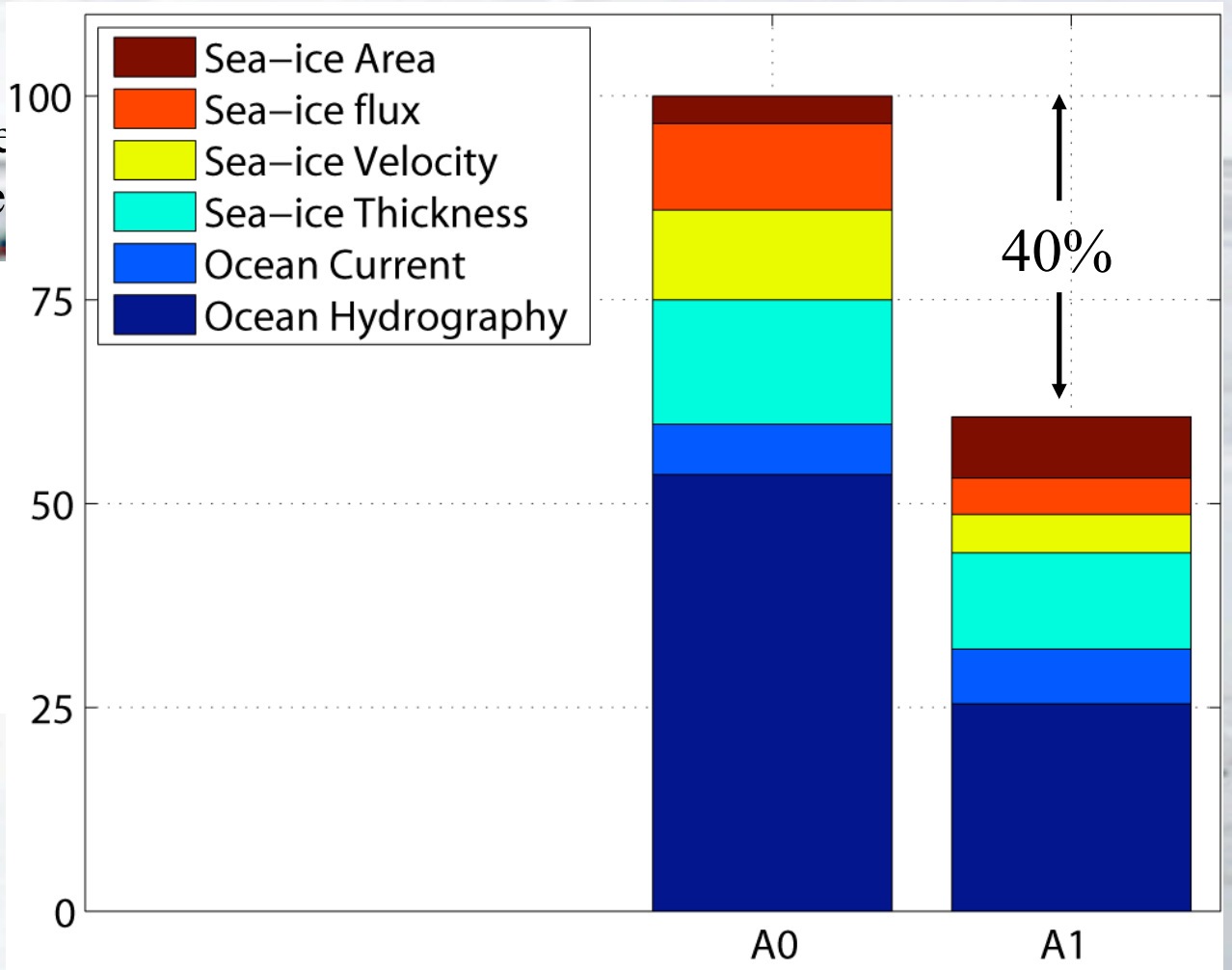
Outline:

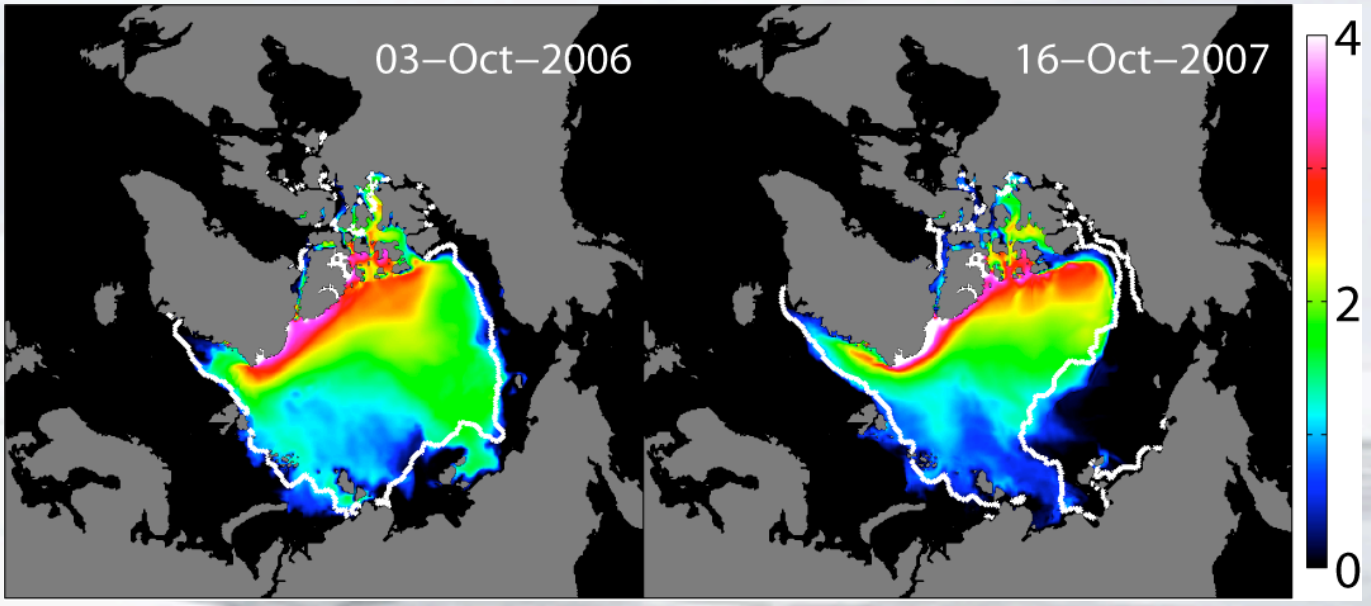
- Optimized solution in the Arctic
- Sea ice:
  - Extent → summer 2007
  - Velocities & fluxes
  - Thickness
- Ocean:
  - hydrography
  - fresh water content
  - heat & volume fluxes
- Summary
  - Arctic solution: 53% cost reduction
  - Greenland Sea

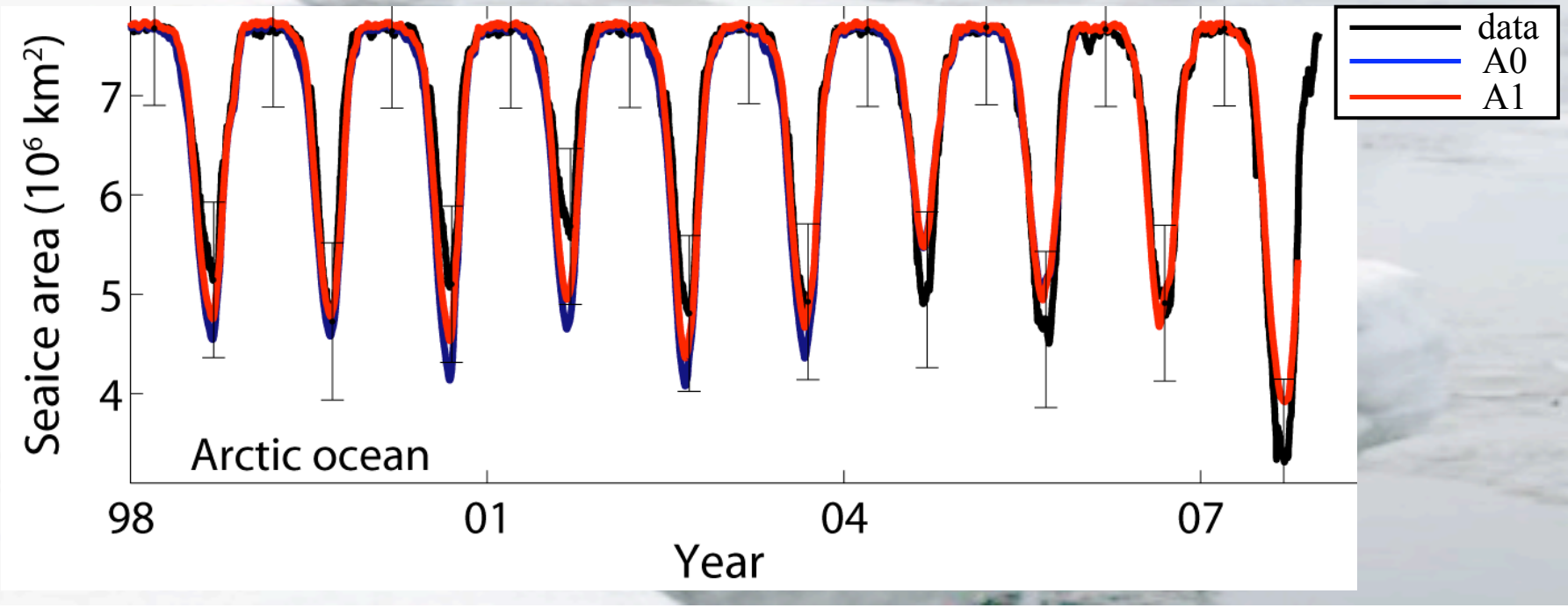
Regional optimized solution:

- Data:
  - Sea-ice velocity, sea-ice thickness, CTD profiles,
  - Initial conditions, Forcings
- Parameters:
  - Salt-plume parame
  albedos, sea-ice stre
  Gmredi
- Solutions:
  Baseline: A
  Optimized: A

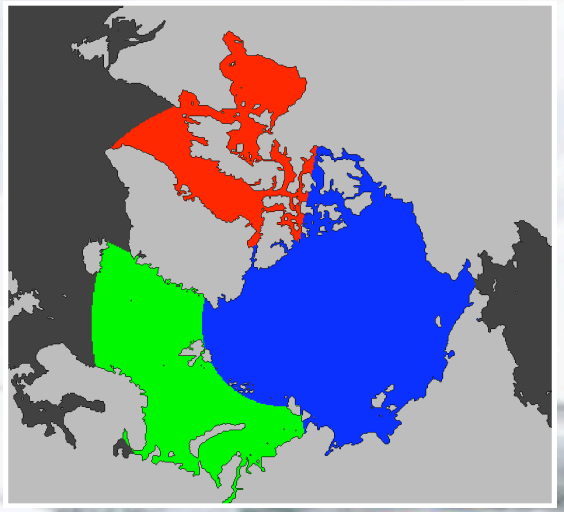


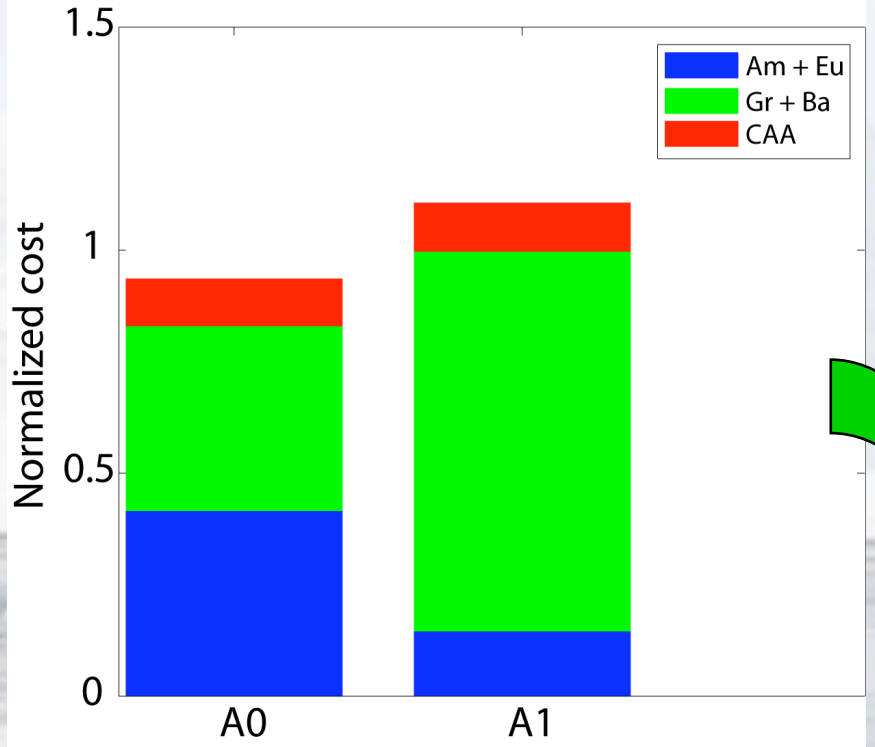
Sea ice extent

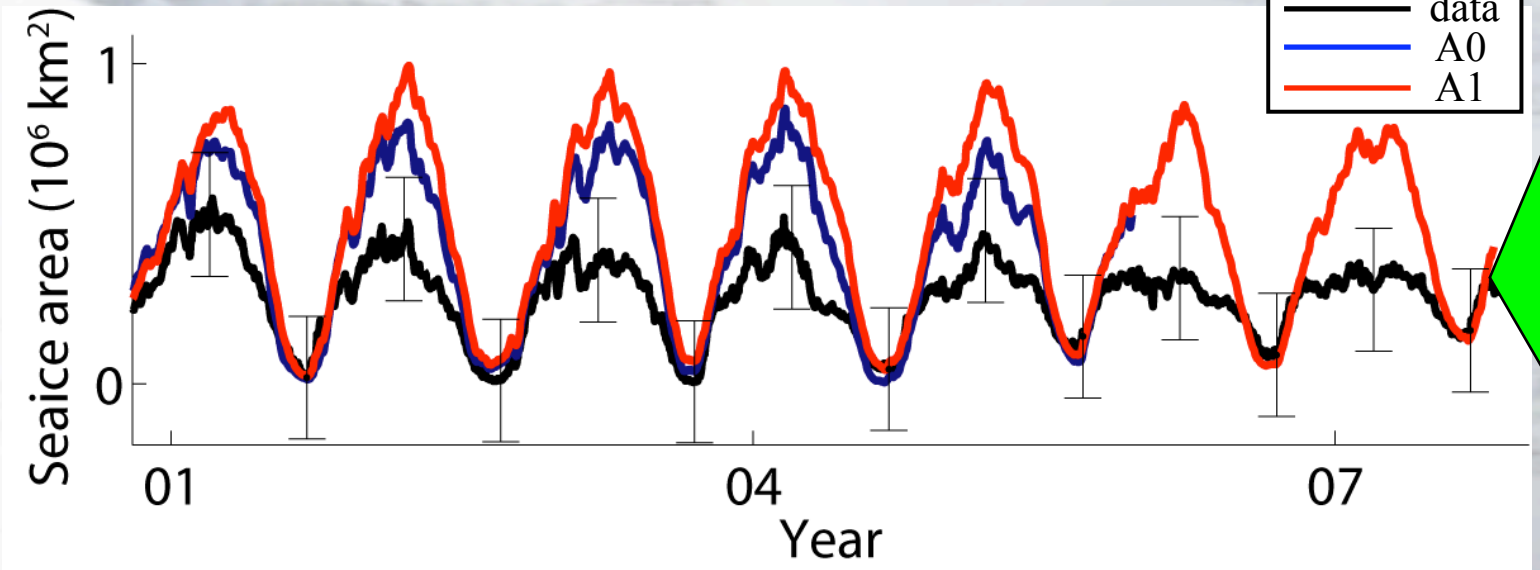




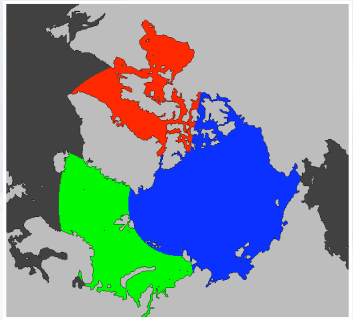
Sea ice extent

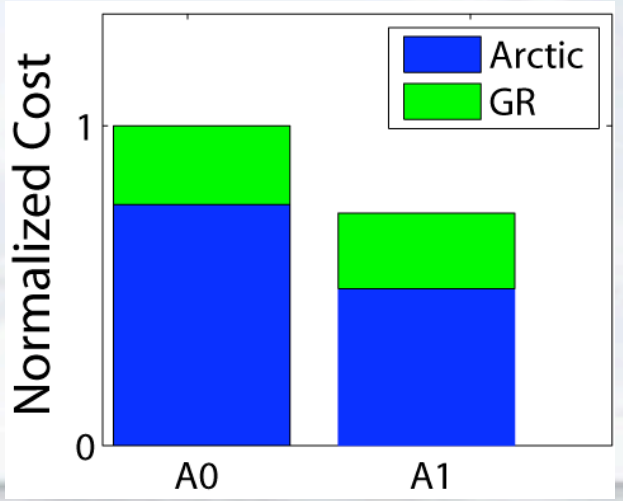




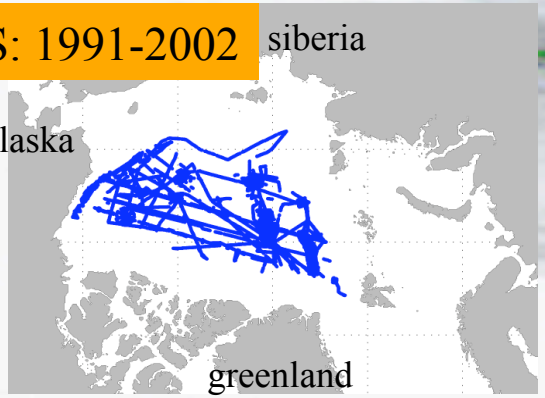


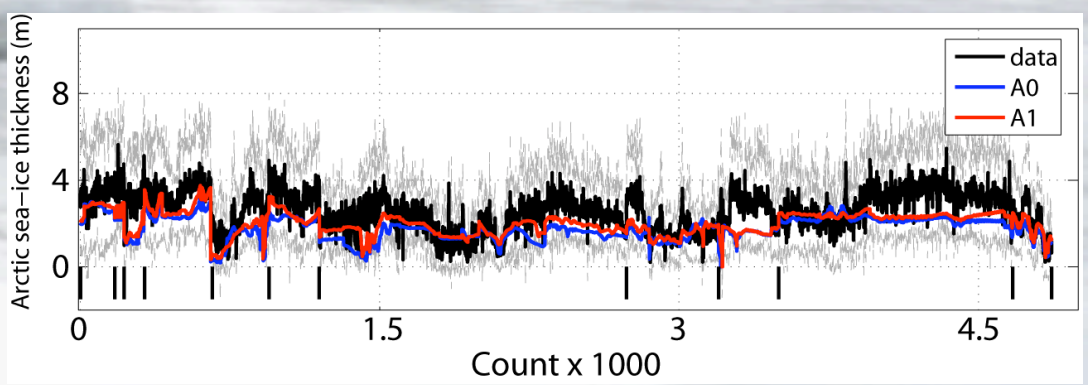
Sea ice thickness





ULS: 1991-2002





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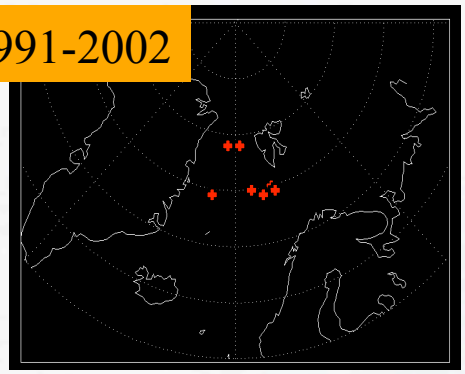
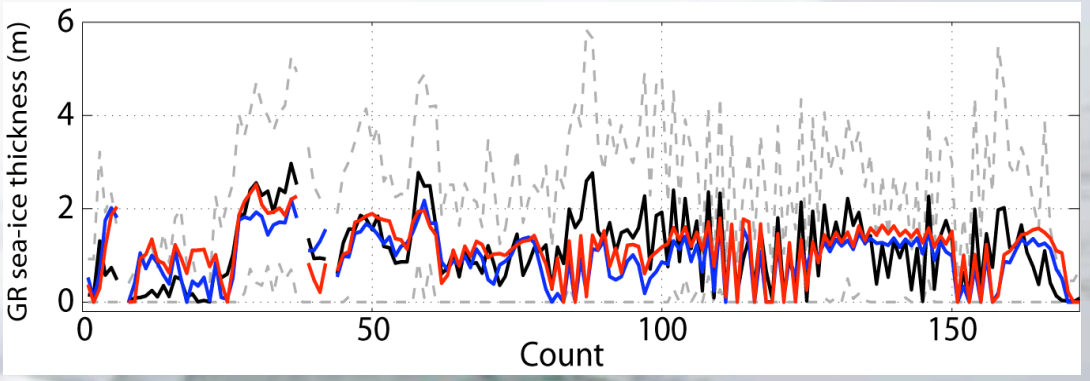
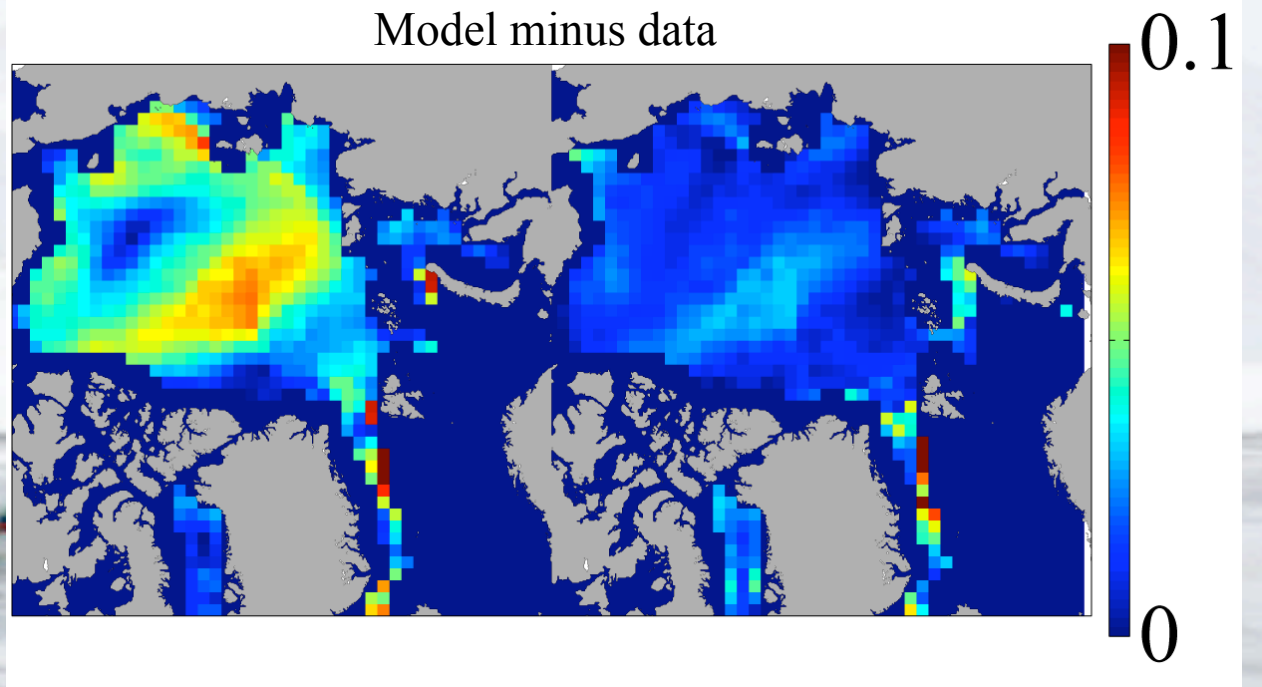
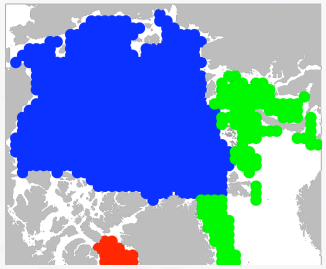


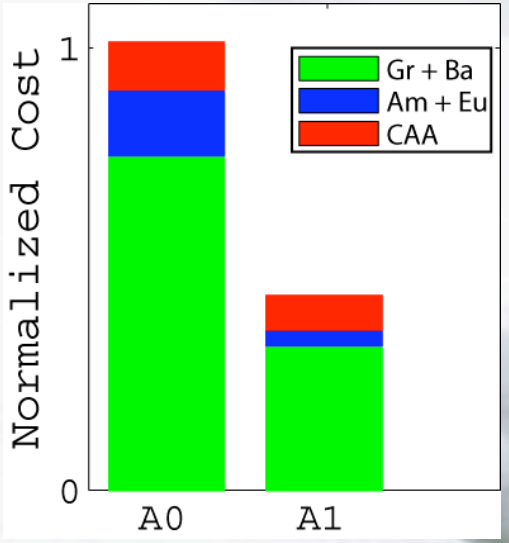


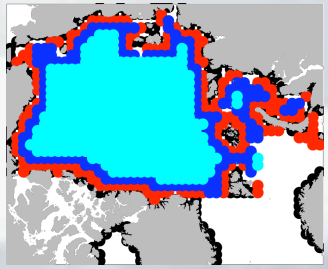
Sea ice velocity

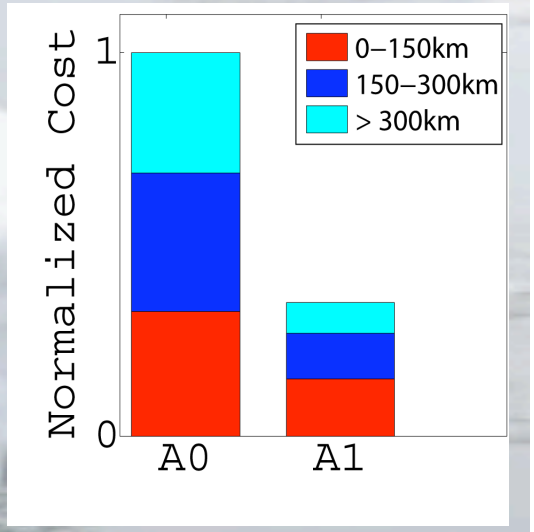
Passive microwave derived
1992-2002



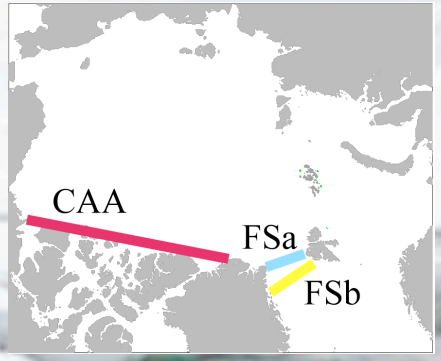


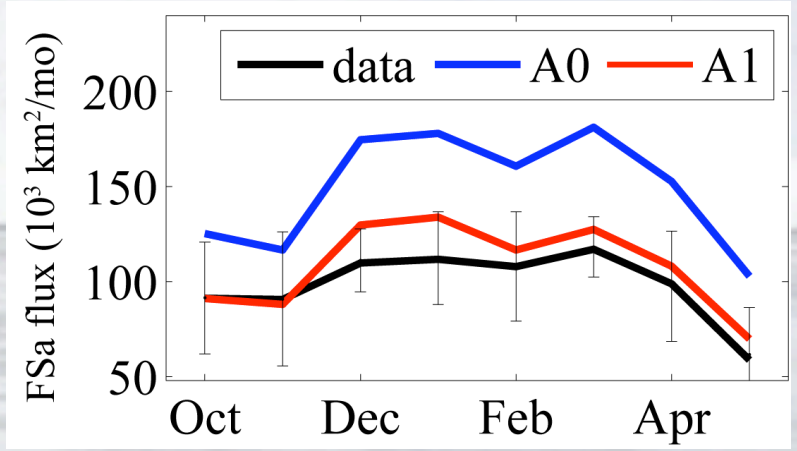


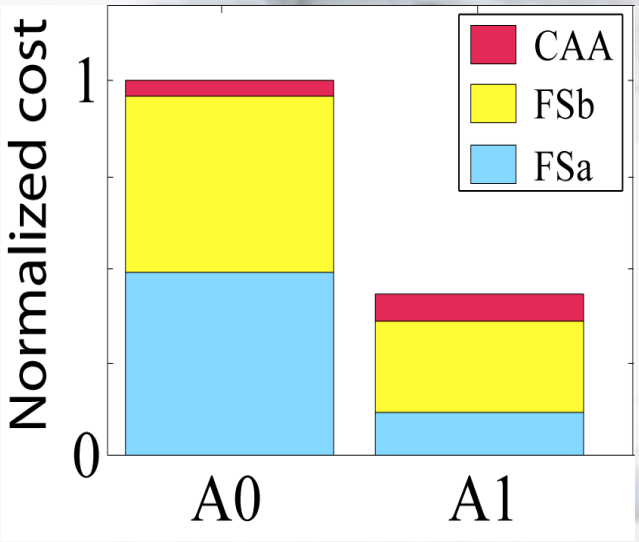


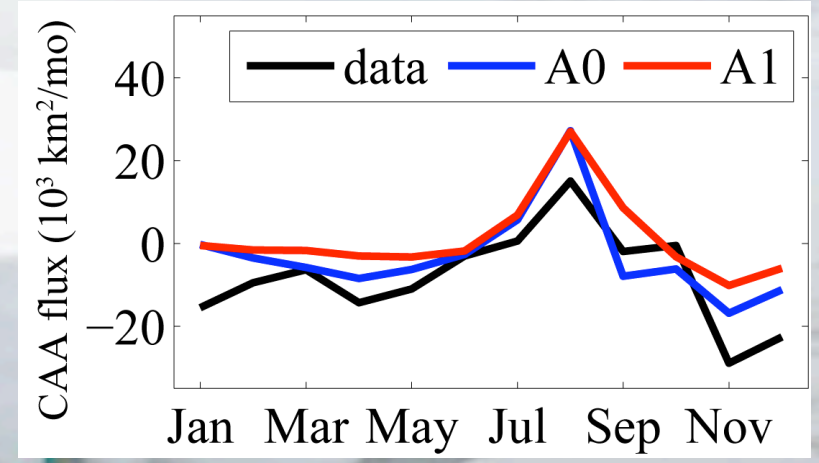


Sea Ice flux: Passive Microwave data: 1991-2002

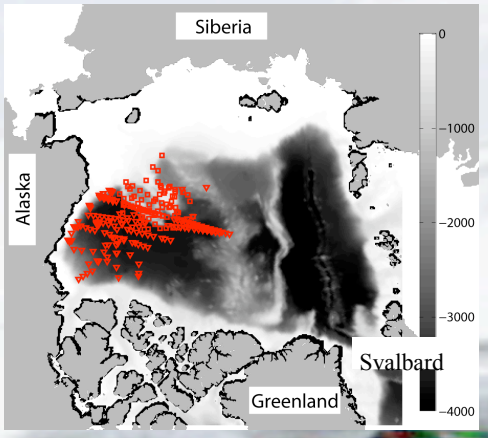


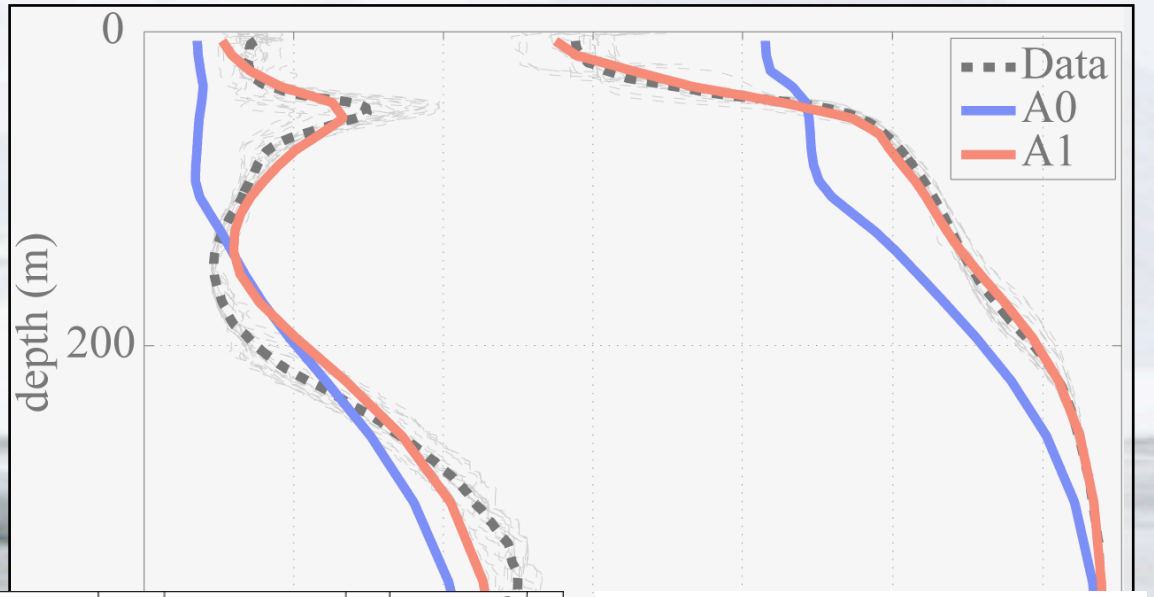


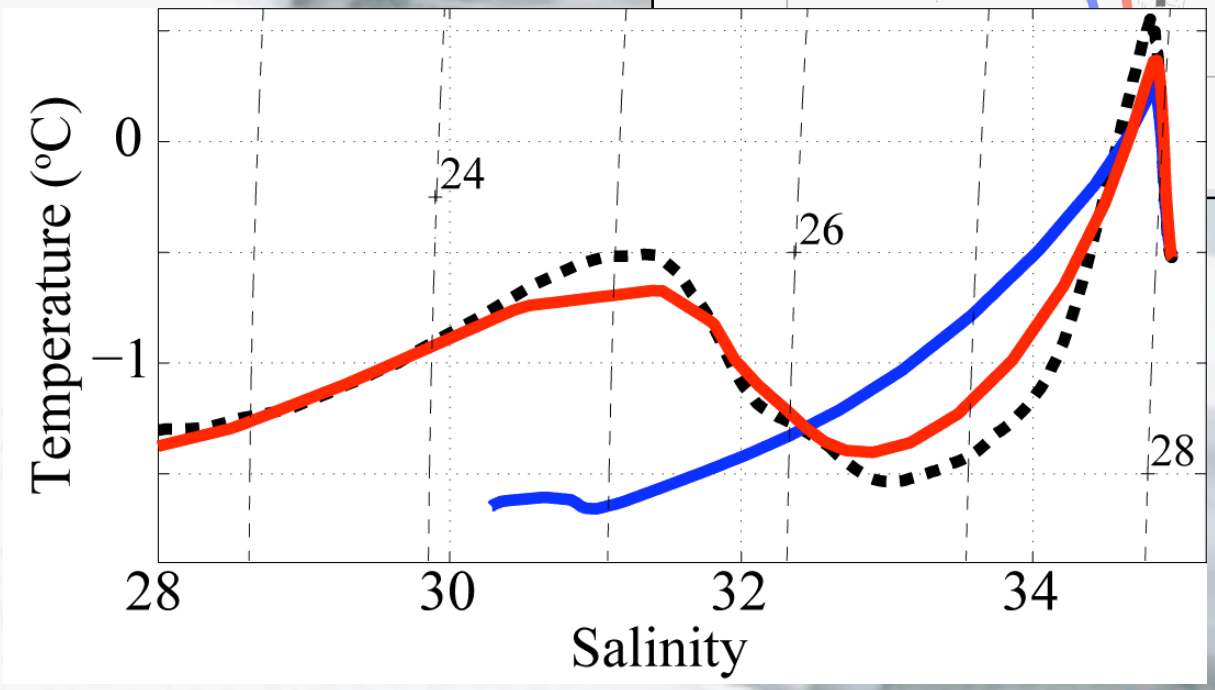


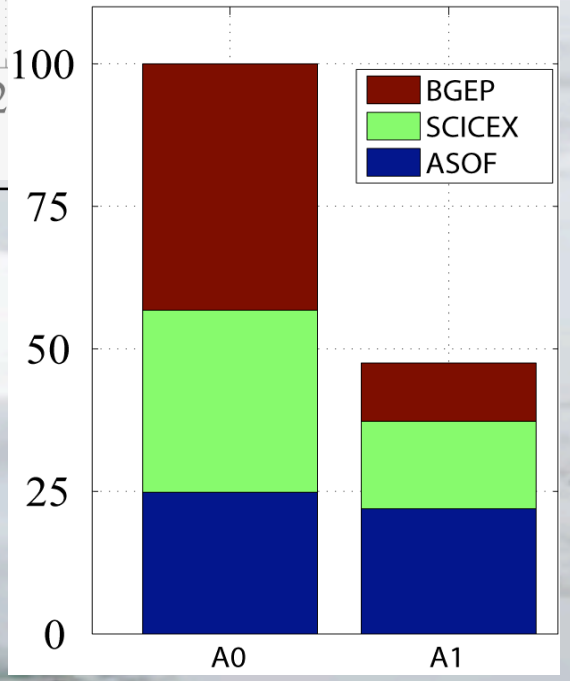


Arctic ocean hydrography

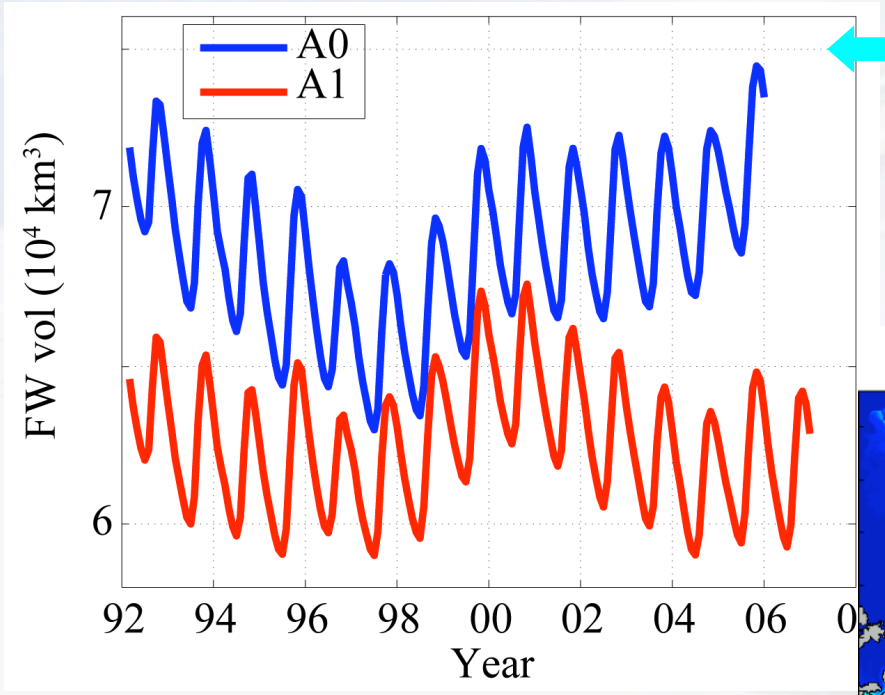




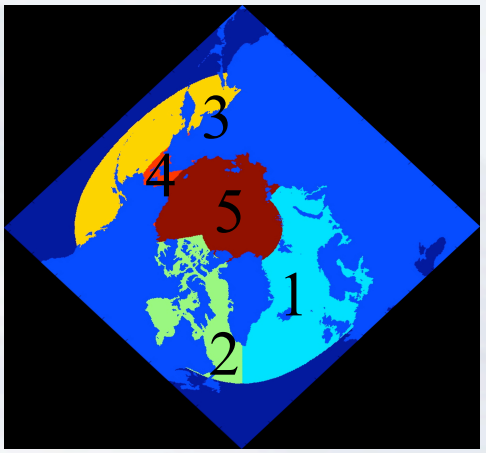


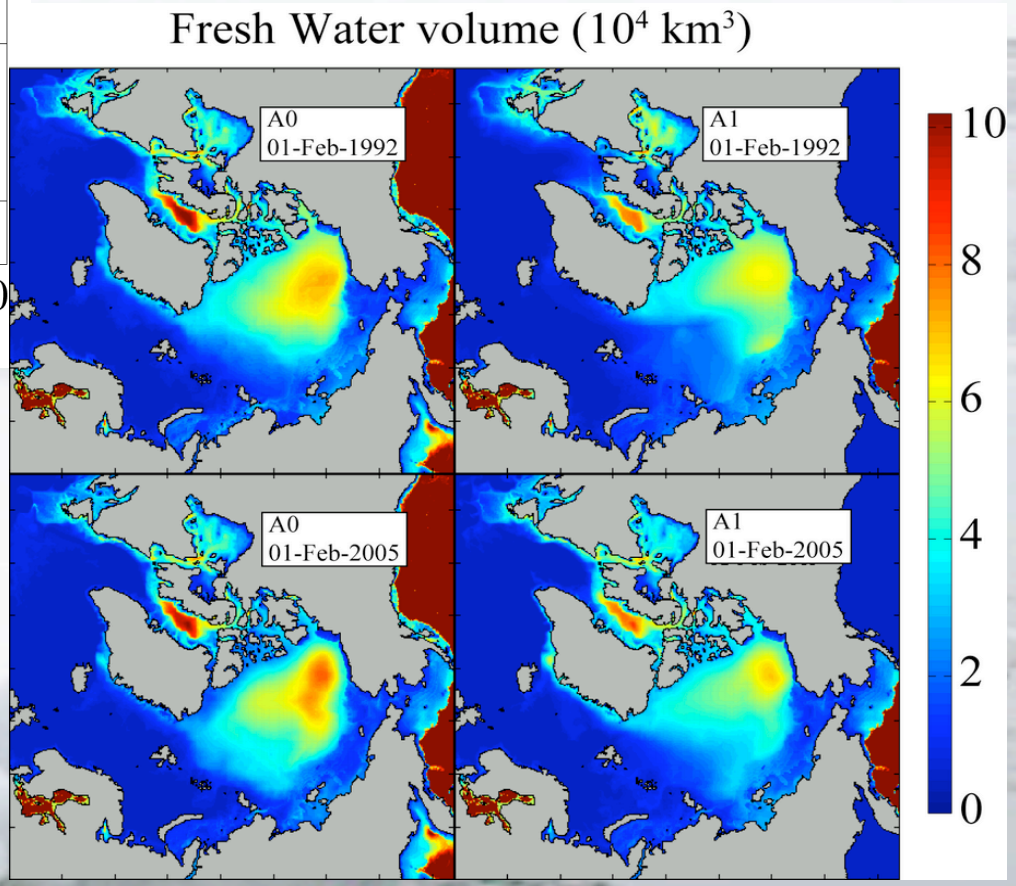


Arctic ocean (5): Fresh water volume:

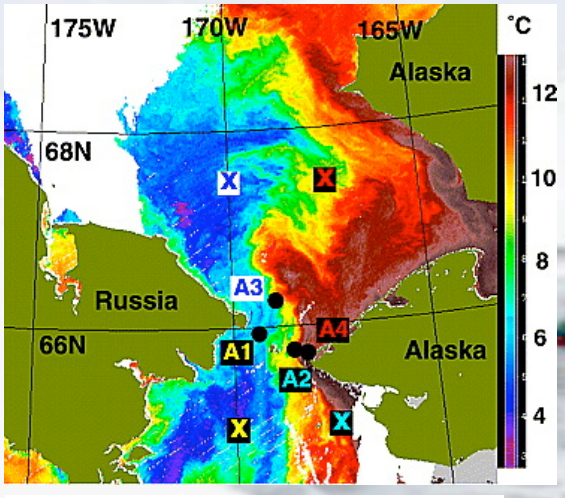


Expect:
~7.5x10^4km^3

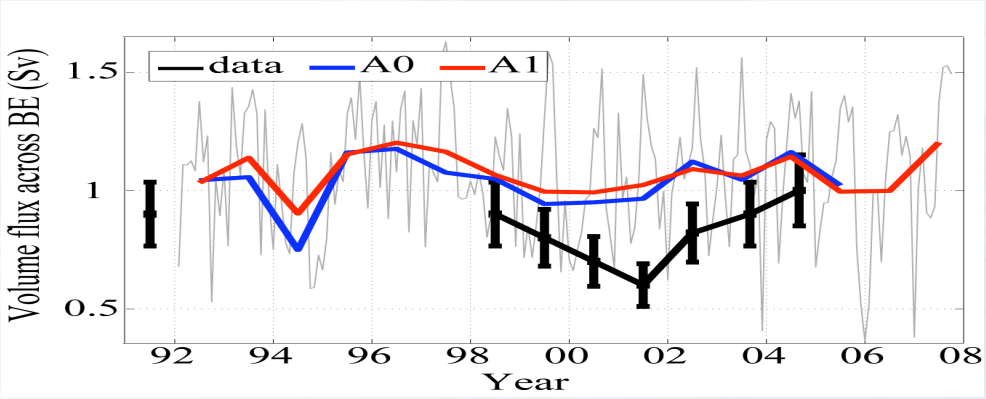


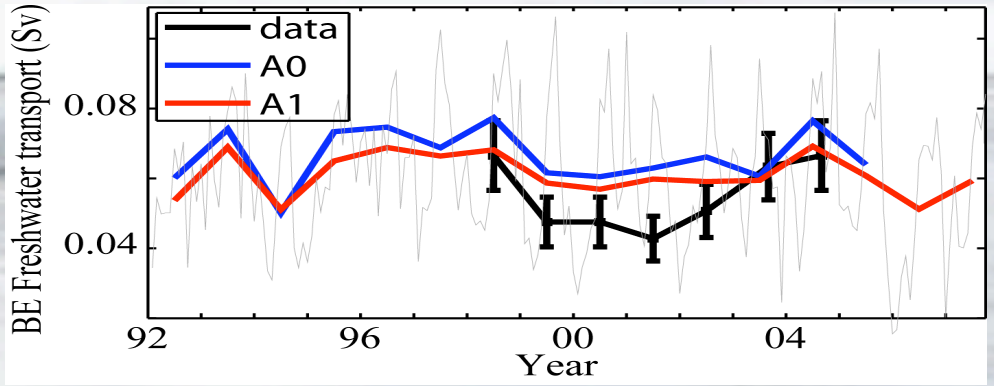


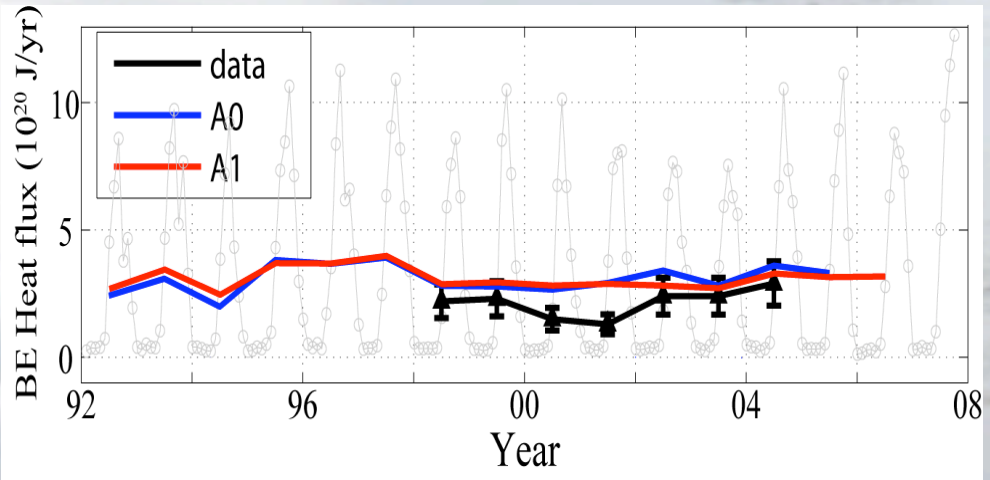
Arctic ocean fluxes: Bering Strait



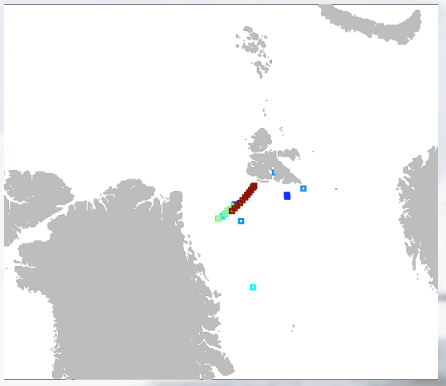
[Woodgate, 2006]

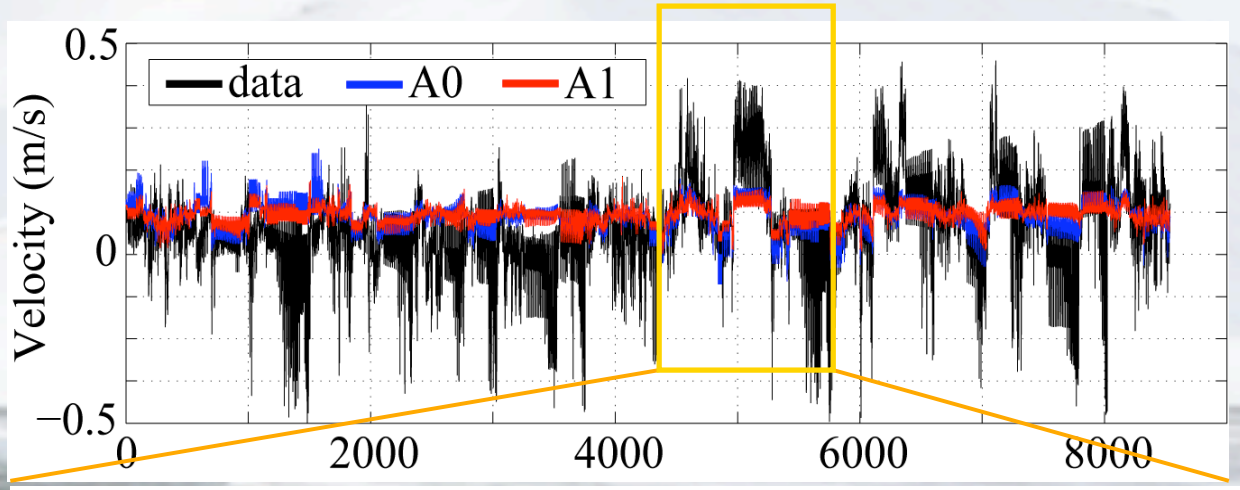


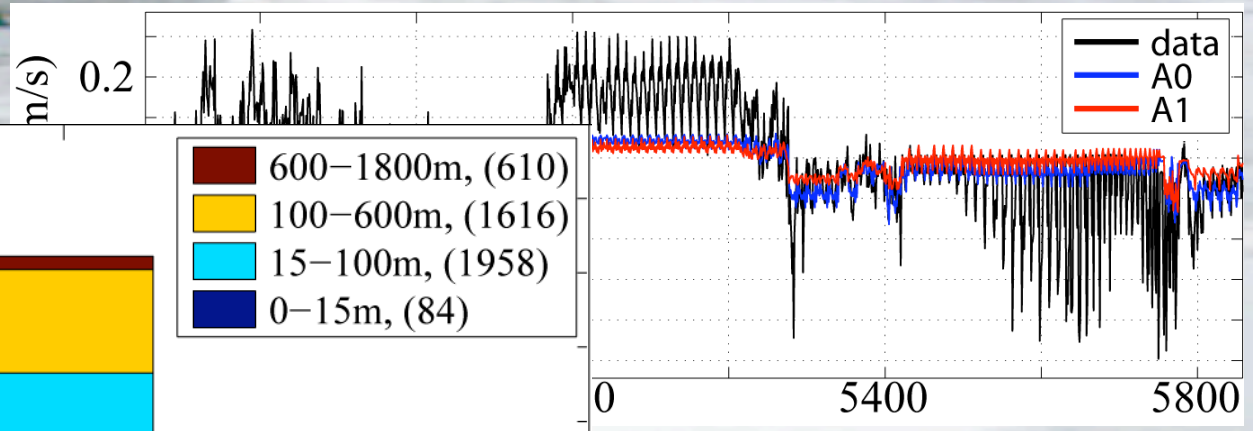


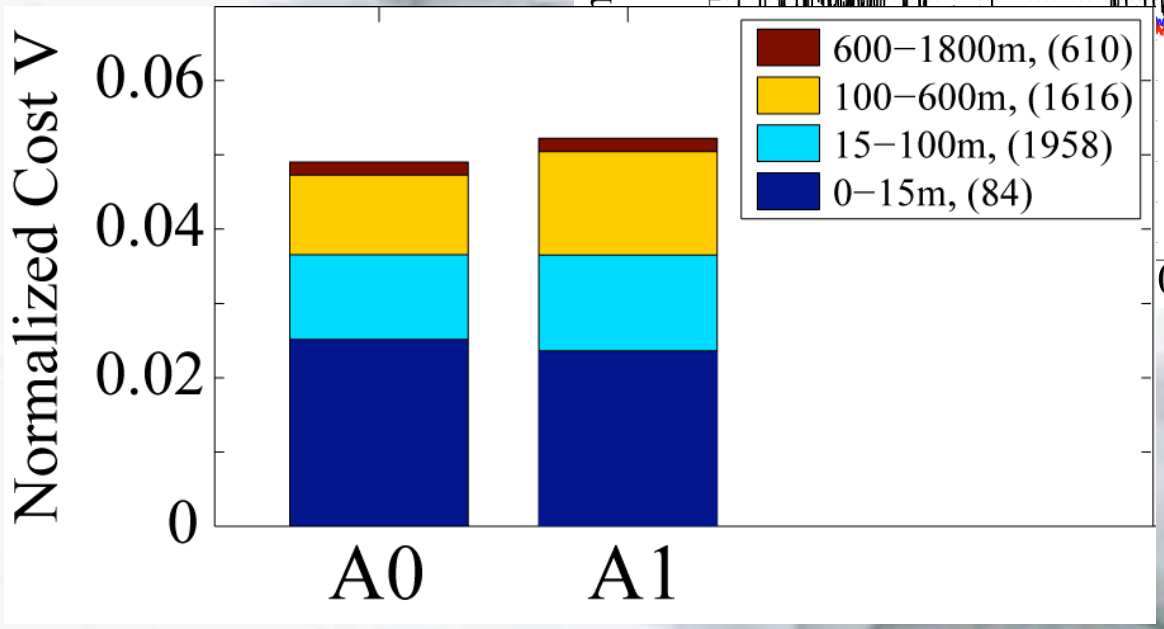


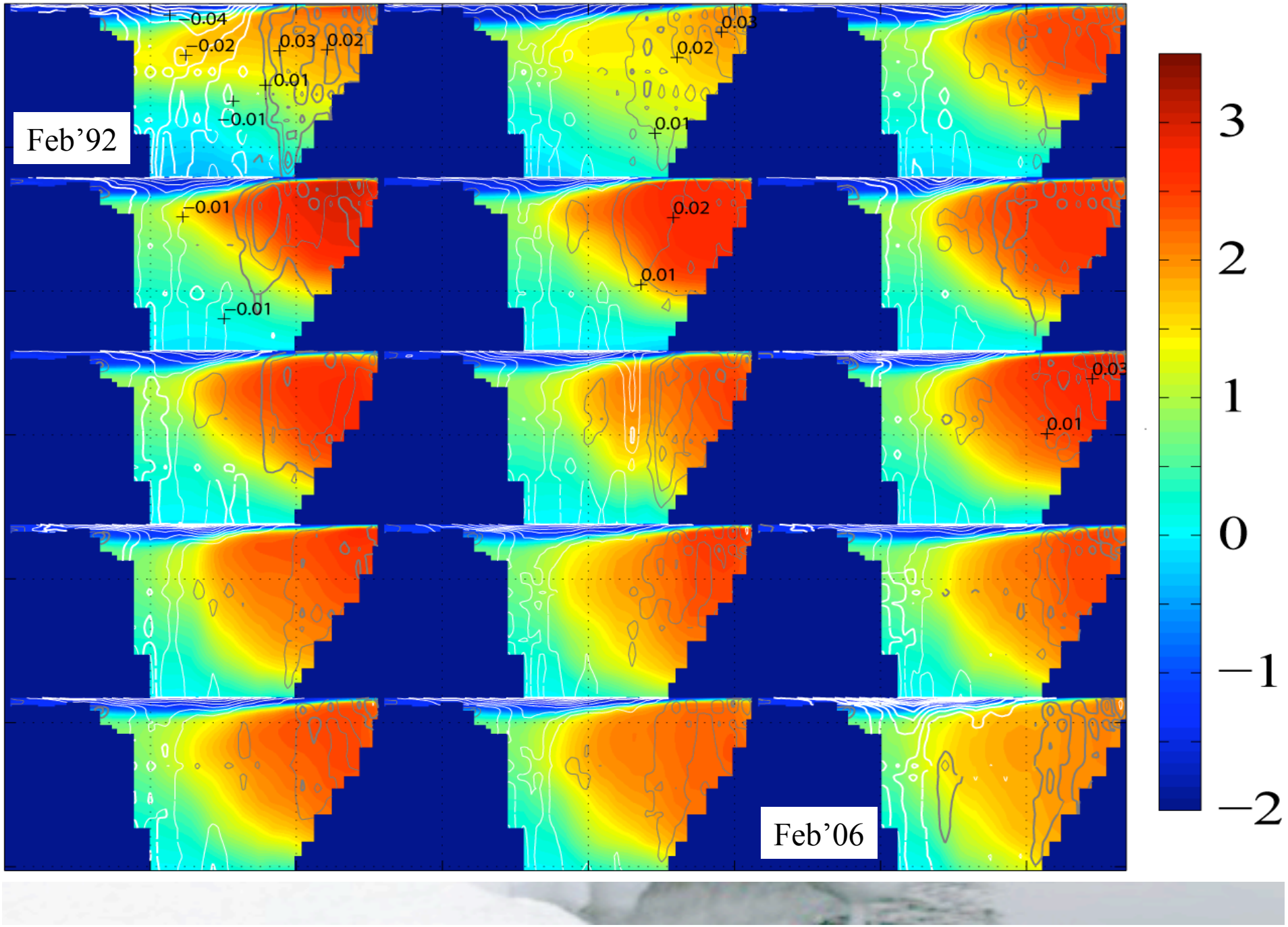
Arctic ocean flux: Fram Strait



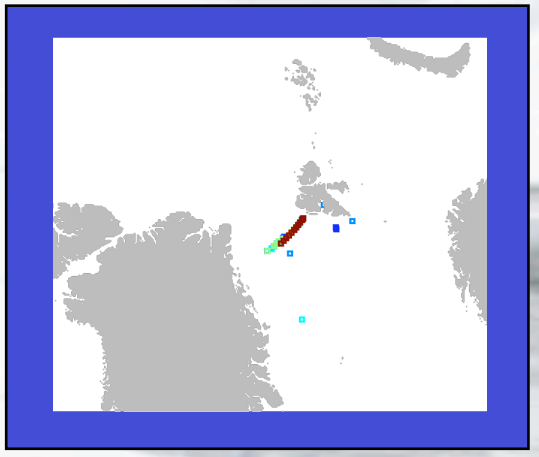


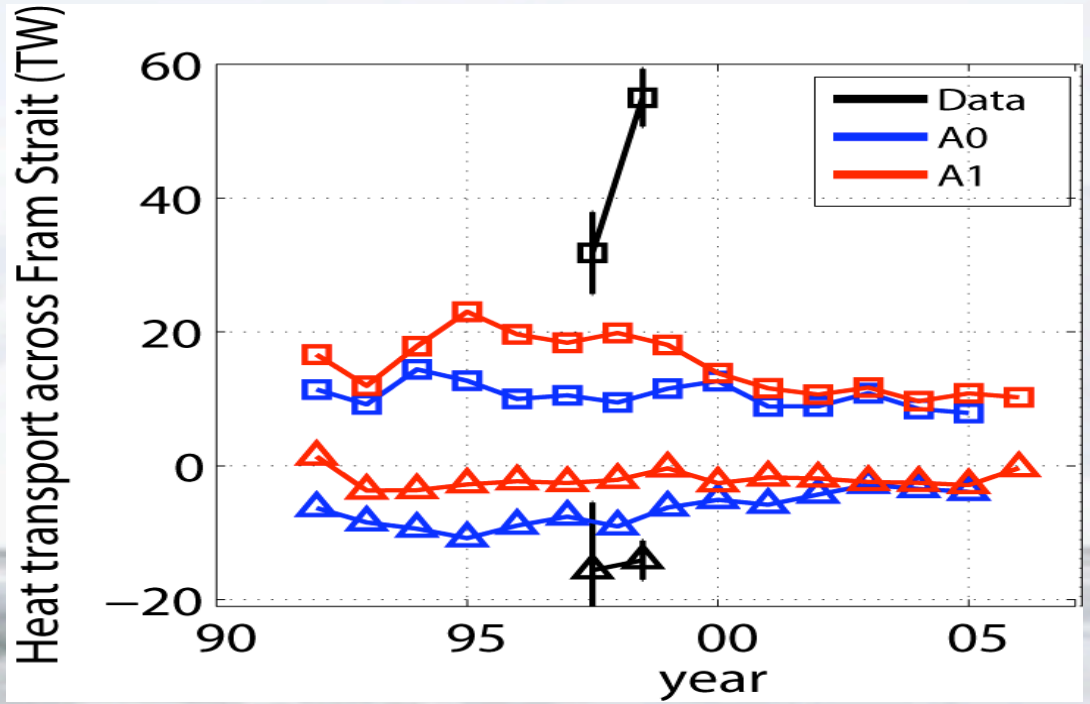


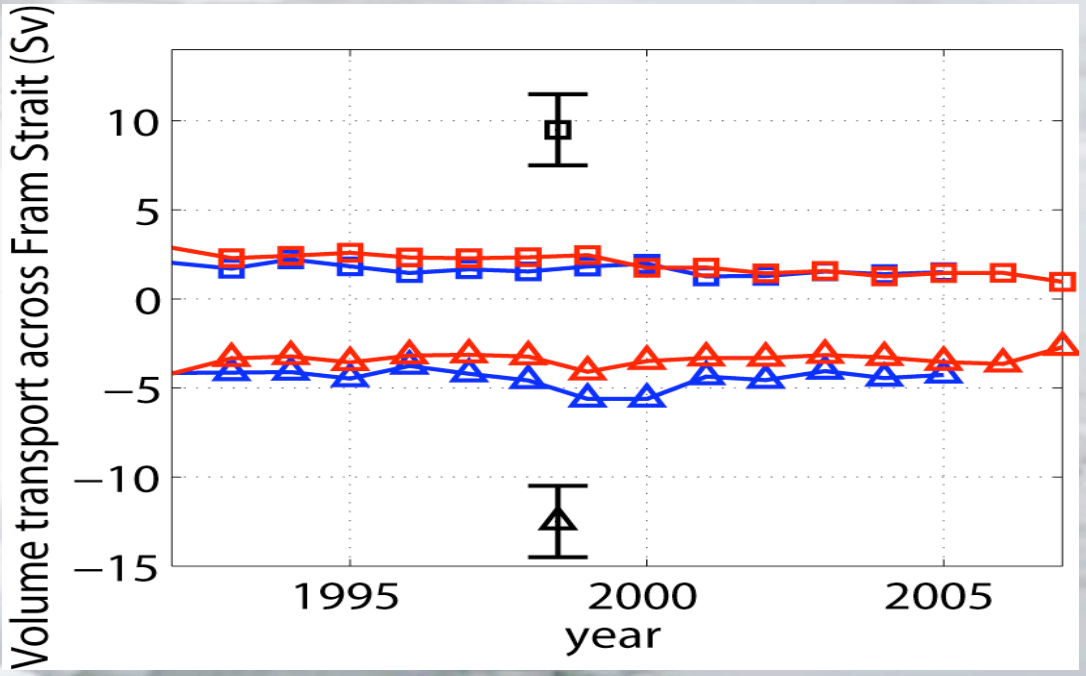



Feb'92
Feb'06
−0.04
−0.02
0.03
0.02
0.01
−0.01
0.03
0.02
0.01
−0.01
0.02
0.01
−0.01
0.03
0.01
3
2
1
0
−1
−2

Arctic ocean fluxes: Fram Strait [Schauer, 2004]

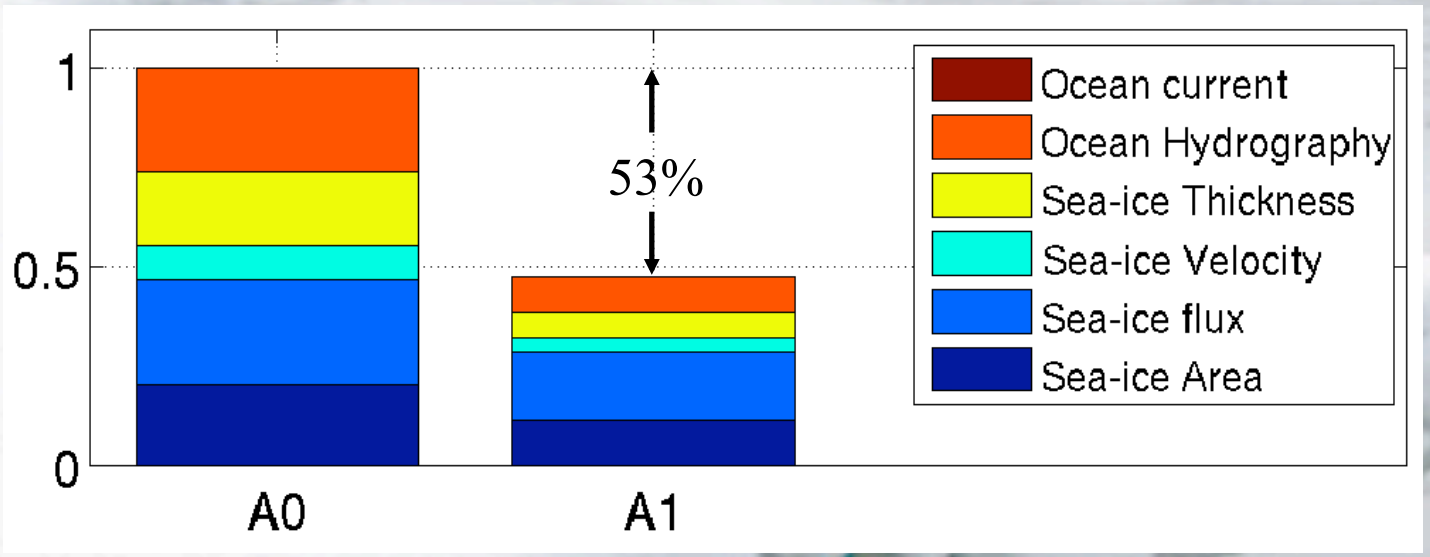






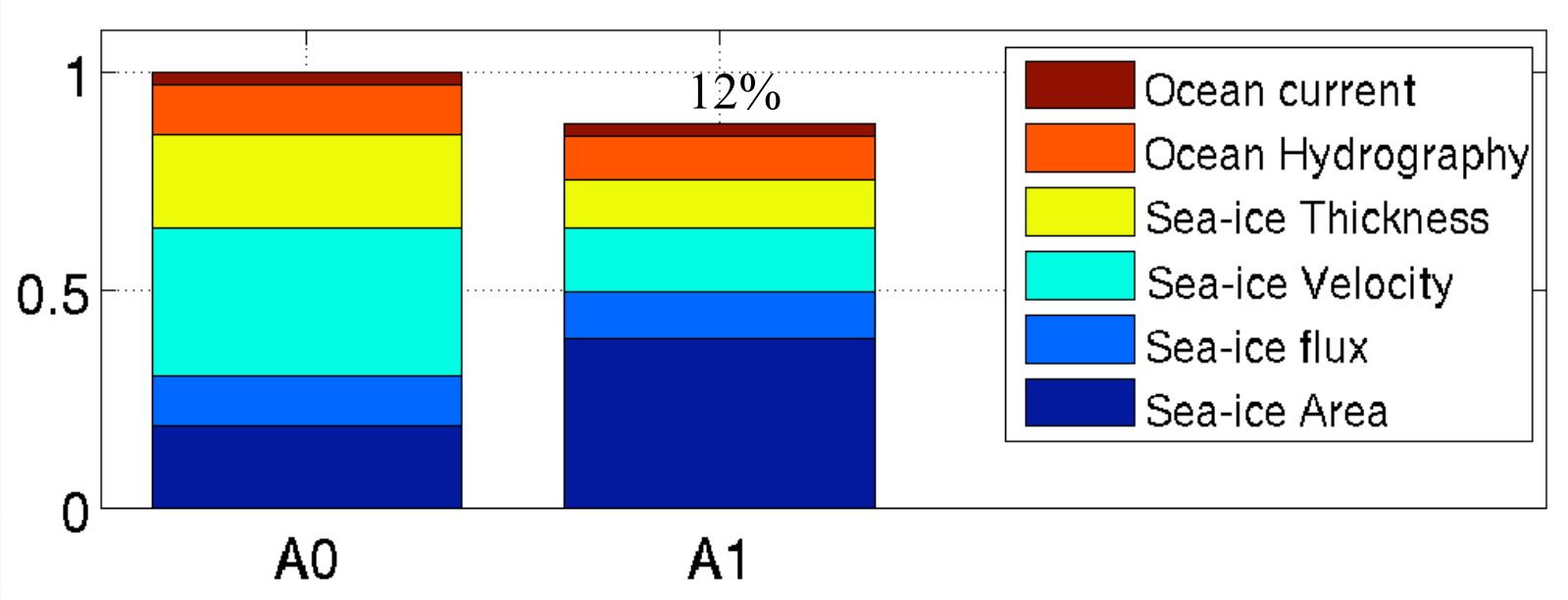
Summary-1:

1) Arctic Ocean:
   - Summer 2007 sea-ice minimum
   - Realistic Halocline
   - Freshwater: compatible with Serreze estimates
   - Berring Strait: all fluxes compatible with measurements from Woodgate [2006]
   - Fram Strait: all fluxes too low compared to Schauer [2006]



Summary-2:

2) Greenland Sea: vertical mixing issues
   → hydrography too diffused
   → weak currents
   → too low heat and volume fluxes into the Arctic

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Summary-1: Sea Ice

1. Sea Ice flux:
   - over-estimates net ice export across Fram Strait by 40% to 60%

2. Sea ice thickness/extent/volume:
   - too much ice extent in winter, too little in summer
   - ice thickness small relative to ULS data in Arctic ocean
   - closer to data in Greenland sea
   - ice volume too small, with positive trend!

3. Sea ice velocity:
   - parallel to wind direction, consistently to the left of data
   - turning angles correlate with magnitude of Δvel

List of things to do (04/13/07):

1) Fix drifts in Arctic domain
2) Fix vertical mixing
   → fix ice thickness + ice vol + fresh water vol?
3) Jinlun's comments:
   - Initial condition for ice thickness: in the wrong season?
   - Ice extent problem in summer: thermodynamics
   - Tear-drop vs. elliptical yield curves:
     might not solve discrepancies of vel near coast
   - Need to check if stresses lie on the yield curve

Sea ice volume